

Title:

**DEVICE AND METHOD FOR ALIGNMENT**

5    **Technical field of the invention**

The present invention relates to a device for alignment of at least one alignable plane with respect to at least one reference plane.

- 10    The invention also refers to a system and a method for alignment of at least one alignable plane with respect to at least one reference plane.

**Background of the invention**

- 15    Usually, at power transmission between rotary shafts, for example via belt or sheave, it is required that the driving and the driven wheels are mutually, at least plane-parallel and adjusted axially in line with each other. This is mainly to prevent abnormal wear of the belts or chains arranged in the power transmission.
- 20    Presently, string and straight edges are used when aligning sheave/gear wheels. The string and straight edge is manually provided on the axial plane of one of the wheels. The string and straight edge is then held in such a direction that its distance to the axial plane of the other wheel can be estimated. This gives however only an estimation of the mutual position and the point of the wheels in one direction, whereby the string and straight edge is turned to a new
- 25    position on the other wheel and a new estimation of the distance between ruler and wheel can be obtained. This distance is compared to the first one in order to obtain an estimation of the mutual position and the direction of the wheel in the other direction. This method, which prevents a simultaneous alignment of the wheels by one operator and the fact that the string and straight edge must be of such a length that it fits the periphery of both wheels makes the
- 30    alignment to become time consuming and inaccurate.

Moreover, alignment with a string and straight edge is normally done by two mechanics.

### The object of the invention and the most important characteristics

The object of present invention is to provide a simple and cost-effective device which allows simple and quick-adjustment and alignment of at least two essentially plane surfaces. The substantially visible light beam used for the alignment shows the parallel and angular misalignment directly.

A further object of the invention is to provide a device mainly intended for adjustments of sheaves/gear wheels in power transmission systems having rotary shafts, preferably through optical measurement, in industrial environment and a corresponding measurement method.

Through the teachings of the invention, the alignment results in reduced vibration, extended life of belt and sheaves, proper belts tensioning and also eliminated downtime and production delays.

Above mentioned objects are achieved by means of the initially mentioned device, comprising a main part, a light source and a number of contact points, and that the light source is arranged to emit a light beam with a scattering angle in one plane.

Advantageously the contact points are displaceable and also arranged as attachment devices.

In one preferred embodiment the light beam has a scattering plane essentially parallel to the alignable plane.

In one most preferred embodiment the device comprises an arm. The arm and the main part are rotatable relative each other. Furthermore, the arm is provided with at least one contact point. Preferably, the contact points are arranged displaceable relative each other and/or relative the device. The contact points are arranged to take optional positions in a plane, area of which is only limited by the physical dimensions of the device, that these contact points independently of position, allow the device to transfer the position and direction from the reference plane in two opposite each other essentially perpendicular coordinates.

The system according to the invention comprises a device consisting of a main part, a light source and a number of contact points. The light source is arranged to emit a light beam with a scattering angle in one plane. The system also includes an indicator device to be arranged on the alignable plane.

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Suitably, said light beam has a scattering plane essentially parallel to the alignable plane. Preferably, the indicator device consists of a part for attachment and a body provided with a measurement mark. According to the system alignment is achieved when the light beam essentially coincides with the measurement mark. Preferably, at least three indicator devices

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are arranged on said plane. In one embodiment, the indicator device is part of said plane. According to a method of the invention for alignment of at least one alignable plane with respect to at least one reference plane so that said planes become essentially plane-parallel, a device is arranged consisting of a main part, a light source and a number of contact points, a

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light beam is emitted with a scattering angle in one plane, an indicator device is arranged on the alignable plane within the area of the light beam provided with measurement mark, and with respect to the measuring mark adjust the alignable plane is adjusted so that the mark coincides with the intersectional line between the light beam and the indicator device.

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### **Brief description of the drawings**

In the following, the invention will be described in greater detail with reference to a non-limiting embodiment shown in attached drawings, in which:

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Fig. 1 is a schematic lateral view of an alignment device, according to the invention,

Fig. 2 shows a schematic view in perspective of an application using the device shown in Fig. 1, and

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Fig. 3 shows the encircled section of Fig. 2 in greater detail.

### **Detailed description of the invention**

A preferred embodiment of an alignment device, according to the invention is shown in Fig. 1. The device 10 comprises a main part 11 and an arm 12. The main part 11 and the arm 12 are rotatably arranged relative each other around an axis 13.

5 The main part is essentially designed with a first end 14 and a second end 15 connected to each other via a neck 16, which also form an accommodation space 17. The main part 11 further comprises a light source 18 and a possible driving unit 19, optical elements and source of energy (not shown) arranged in a space in the first end 14. The second end is arranged with a journal 13, which pivotally connects the main part 11 to the arm 12. In the neck section 16  
10 the main part is provided with a recess 20, which in this embodiment carries two attachment devices 21a and 21b displaceable relative to the main part. The space 17 is provided to receive the arm 12 when it is rotated therein, which for instance facilitates the handling and the storage of the device.

15 The arm 12 is also provided with a recess 22 in the direction of its longitudinal axis, which also carries an attachment device 21c displaceable in the recess 22.

Preferably, the attachment devices 21a, 21b and 21c consist of magnets in one end, which can be fixed in the recess by means of a locking device (not shown) for example a nut or the like  
20 in a known way. Other additional attachment devices, for example different types of fastening means, suction cups, means for adhesion etc. may also be used. It is also possible to provide separate attachment means and contact points.

Preferably, the light source 18 consists of a laser emitting device, for example a laser diode,  
25 but other light sources may also be used. By means of for example optical elements (not shown) the light beam from the light source can be scattered, preferably essentially parallel to that/those planes that must be aligned. The driving unit can also be controlled by means of a switch arranged in the main part (not shown).

30 An application for alignment and adjustment of two sheaves 23 and 24 is shown in Fig. 2. A light beam 25 is emitted from the light source 18. This light beam 25 is formed with a relatively large scattering angle in one direction and a very small scattering angle in remaining

directions and creates along its extension a plane of light (essentially parallel to the plane of the wheels).

5 The device 10 through the arm 12 is fastened on a reference part which normally consists of one 24 of the two sheaves, for example in a belt transmission. The device is fastened by means of the three attachment devices (or contact points) 21a, 21b and 21c provided with magnets, which take optional positions and are distributed in as great mutual distance as possible and bear on the surface situated close to the periphery of the reference 24. This distributing is enabled through the recesses 20 and 22 and also through the mutual articulated  
10 features of the arm 12 and the main part 11 around the axis 13. The plane that the attachment devices form, is limited only by the area of the physical dimensions of the device. These contact points independent of position, allow the device 10 to transfer from the reference plane the position and direction in two to each other essentially perpendicular coordinates.

15 The function of the magnets is now partly to fasten the device onto the reference plane and partly to transfer the position and direction of the reference plane to the light beam 25.

On the other sheave 23 a number of indicator devices 26 are arranged. According to the present, preferred embodiment three indicator devices 26a, 26b and 26c are provided. Each  
20 indicator device, of which one is shown in greater detail in Fig. 3, includes an attachment device 27, a body and a reference mark 29 arranged on the body. The attachment device 27 may consist of a magnet or the like. The distance between the mark 29 and the end fixed to the object to be measured of the indicator device preferably corresponds to the distance between the scattering plane of the light beam and the end of the attachment device, which  
25 contacts the reference plane.

When aligning, the light beam 25 is brought to encounter the indicator devices 26a, 26b and 26c placed on the measured object 23, i.e. the other of the two sheaves in the belt transmission. Because of the essentially great scattering angle of the light beam and the  
30 distance to the object to be measured a simultaneous strike of all the indicator devices is enabled. Each mark 29 on each indicator device has a fixed distance from the measuring object 10 and when it is adjusted so that the light beam 25 essentially encounters the centre of

these marks 29, the measured object 23 is plane-parallel to and in line with the reference 24. The non plane-parallelism of measured object 23 results in a distance  $l$  between the mark 29 and the point of impact of the light beam (Fig. 3) on each individual indicator device. Plane-parallelism exists when  $l = 0$  (or  $l = 0$ ) at each indicator device and the intersectional line of the light beam essentially coincide with the mark 29.

In one embodiment the indicator devices may consist of sensors, which are able to sense the light beam. Preferably the adjustment of the object to be measured can be done automatically so that it is placed plane-parallel with the reference object. Suitably, this can be achieved continuously. In one embodiment a part of the object to be measured may be provided with a reference mark, which is used instead of the indicator devices.

By adjusting the object to be measured 23, advantageously both in axial and radial directions, plane-parallelism is achieved between the sheaves.

While we have illustrated and described a preferred embodiment, according to the invention, it is realized that variations and modifications within the scope of the attached claims may exist. The invention may advantageously be used in all applications where two objects must be aligned plane-parallel or essentially plane-parallel. These objects may also comprise of, for example walls, tabletops, glass, ceilings etc. The design of the device may also be varied by arranging it with three or more arms, or a fixed body provided with a number of recesses in different directions carrying displaceable attachment devices.

Furthermore, the reference marks of the indicator devices may be arranged in the longitudinal direction of the body, whereby plane-parallelism is achieved when an essentially right-angled cross with respect to the intersectional line of the light beam is obtained. Even the light beam may be emitted in the longitudinal direction of the indicator device whereby the reference mark may be arranged along its longitudinal direction or opposite its longitudinal direction.